At the core is a debate about the value that DERs provide to the grid

- What is the locational (T&D deferral) value given the uncertainty in growth?
- How much value do specific DERs contribute given their characteristics?
Why use granular probabilistic planning methods?

- No one knows precisely when loads will exceed ratings or by how much.
- Linear forecasts assume precise knowledge. Actual growth trajectories are rarely linear.
- Because a linear forecast assumes exact knowledge, no value is assigned to the years an infrastructure upgrade is assumed to occur.
- Forecasts inherently become more uncertain further into the future.
- Probabilistic methods, on the other hand, reflect the potential reality that infrastructure investment could be triggered earlier.
- They assign value to periods earlier than the linear forecast would dictate.
No one knows in advance precisely what path load growth will take.

Illustration of Individual simulations

Each simulation produces a potential trajectory that factors in the growth trend, uncertainty in the trend, year-to-year variation in growth, and the relationship across years.

Some outcomes are far more likely than others.
Several factors affect locational value of DERs:

- Projected load growth rates
- The amount of existing excess capacity
- The magnitude, timing and cost of T&D upgrades
- Load shape of needed curtailments
- Timing and duration of risk

Locational Value
Concept #1: Excess capacity (or lack thereof) is a key driver of location value.

Different amounts of excess capacity affect the timing upgrade and the likelihood it will be needed.

Whereas generation and transmission infrastructure is sized to cover the system demand over broad geographic regions, distribution infrastructure is sized to cover the coincident demand of much smaller geographic areas, whose locational capacity needs can be quite diverse.
Concept #2: Projected growth rates affect locational value

- If loads are declining, a wait and see approach may be advisable.
- If loads are growing too fast, the amount of time a project may be deferred is minimal.
Concept #3: The magnitude, timing and cost of growth related T&D upgrades drive locational value

Locational capacity value is driven by the deferral of traditional distribution investments

The locational value will be greater were higher value investments can be deferred for longer

The savings is the difference in the time value of money between investments with and without demand management

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Concept #4: Load shapes matter and can vary substantially by location

Peak day - July 18 2013

Network - Evening peak

Network - Day peak

Network - Other peak

Radial
Concept #5: Timing and duration of risk drive local capacity need
We must ask the right questions to understand DER value

1. **Is the DER tied to a specific load shape?**
   - How well does the resource shape align with local peaking risk?
   - Does it provide negative value for some hours (e.g., load shifting, snapback)

2. **Is the resource flexible?**
   - Can it be dispatched with different start and end hours?
   - Can the magnitude of output be controlled (ramping)?
   - How far ahead must it be scheduled?

3. **Are there specific operating constraints?**
   - When is it available?
   - For how long can the resource be sustained?
   - Are there limits on how often or when it can be dispatched?
   - What is the realization rate (e.g., percent of projected load relief that is actually delivered)?

*The DER characteristics affect the value they provide at each location*
How many hours of relief are needed? When do they occur? For how long must production (or reductions) be sustained?

Hourly loads on days above cutoff

10% Reduction
- 11 am to 9 pm
- 53 hours over 2010–2014
- 8 days

5% Reduction
- 1 pm to 6 pm
- 16 hours over 2010–2014
- 4 days

The number of target hours, duration, and frequency of dispatch will vary by distribution area.
The historical load patterns can help assess if DER characteristics and constraints materially affect the ability to deliver resources when they are most needed.

Resource characteristics impact the ability to shave loads
Impact of a four hour duration constraint

On the peak day resources are needed from 11 am to 8 pm. A four hour resource provides incomplete coverage.

Blue bars reflect hours were the 4 hour resource provides coverage (with optimal dispatch)

Green bars reflect hours were the 4 hour resource cannot provide coverage because of the 4 hour dispatch limit
Value very much depends on how well characteristics of DERs align with local demand management needs.
The whole is more important than the parts: maximizing DER value is a portfolio optimization problem, like building the optimal car.

The optimal car...
- The “optimal” car is the one that provides the right balance of cost, reliability, speed, size, etc. for the available budget

What kind of car is being built?

needs the right parts...
- A car without wheels is not useful for operation and it is superfluous to purchase two engines

Are there functional quantities of each part?

with the best value
- Purchasing only the cheapest parts or parts all from the same vendor may not provide the best value

What delivers the best value for the price?

FAST
GOOD
CHEAP
Real world example: Solar + batteries

How well does solar cover the need?

Area 1

Area 2

Area 3

Area 4

Hours with peaking risk ranked by need
For comments or questions, contact:

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Key steps in estimating location specific forecasting and T&D avoided costs

Planning methods are changing from deterministic to probabilistic and from top down to bottom up.

- Clean the Data
- Estimate Historical Load Growth
- Simulate Load Growth Trajectories
- Estimate T&D Costs with and without DERs
- Time Differentiate Value